

# NOTES ON ROOT BEHAVIOR OF CERTAIN TREES AND SHRUBS OF THE ILLINOIAN TILL PLAIN OF SOUTHWESTERN OHIO

E. LUCY BRAUN,  
The University of Cincinnati

In connection with studies of the vegetation of the Illinoian till plain,<sup>1</sup> certain peculiarities of root systems were observed which appear to be due to local environmental conditions. Furthermore, the adaptability of the root systems there displayed is an important factor in determining the ability of certain plants to occupy these areas.

The Illinoian till plain is a flat or nearly flat upland very imperfectly dissected by streams. In consequence, run-off is slow and drainage conditions poor. The fine impervious soil, a deeply weathered and leached drift, further accentuates the poor drainage conditions. Except in periods of extreme drought, the water table is close to the surface; in wet seasons and almost always in spring, it coincides more or less with the surface. In the shallow depressions, water stands sometimes for many months. Such soil conditions result in poor soil aeration.

Responses in direction of root growth to the poor drainage and aeration conditions are evident in the superficial root systems of many of the plants. The present paper is intended to give an idea of root behavior displayed, but is in no sense a detailed study of root systems. Rather it is suggestive of the importance of root behavior in an extreme environment as a factor in species competition and forest development.

Certain of the trees in wet soil develop swollen bases or buttresses and roots widely spreading at the surface. White elm (*Ulmus americana*) has roots near the surface which arch above the ground in the wettest places. It may also have prominent buttresses which sometimes give a broad pyramidal form to the tree base (Fig. 1B), or which extend out many feet in narrow plank-like projections (Fig. 1A). A grotesque and almost inexplicable form is shown in Fig. 1C.

---

<sup>1</sup>Forests of the Illinoian till plain of southwestern Ohio. Ecol. Mon. 1936.

The superficial and spreading habit of the roots of beech (*Fagus grandifolia*) is even more pronounced than is that of white elm (Fig. 2A, B). The large spreading roots are at the surface of the ground and even arch above it; a dense mat of fine fibrous roots fills the upper three to five inches of soil. The main roots at the trunk may amount to props elevating the trunk so that at its base it is not in contact with the soil (Fig. 2C). Arching of the main roots at or near the trunk is sometimes seen (Fig. 2D). In situations where the large roots are exposed, beech sends up abundant root shoots. The shallowness of the root systems of beech in wet and poorly aerated soil resulted in high mortality of this tree in depressions in the 1930 drought.

Large sweet gum trees (*Liquidambar styraciflua*) occasionally have superficial roots. In this species there is no accompanying enlargement or buttressing of base (Fig. 1D). Examination of the root system of very young trees shows strong development of laterals and pronounced twisting or curling of the tap root.

The larger roots of red maple (*Acer rubrum*) commonly spread at or near the surface of the ground, though not in as pronounced a manner as do those of white elm and beech.

Pin oak (*Quercus palustris*) develops a strong tap root; even in this species, however, the tap root may become considerably bent or twisted, but fine superficial roots do not develop.

The superficial root habit is assumed partially in response to poor aeration in saturated and water-logged soils. This will not, however, account for such peculiar forms as shown in Figures 1C and 2D; neither will it account for the arching habit of some, unless this position was taken when the water table was much higher than now. Frost action in a fine-grained soil is a factor tending to heave roots and young trees. This is sometimes evident in the case of saplings about one inch in diameter. Hence, while largely a response to soil water and air, the features of tree roots here mentioned may be due in part at least to the heaving action of alternate freezing and thawing.

The assumption of shallow root systems by elm, red maple and beech, particularly, increases root competition and may be a factor in accounting for the paucity of vegetation in the ground layer in communities in which these species are important

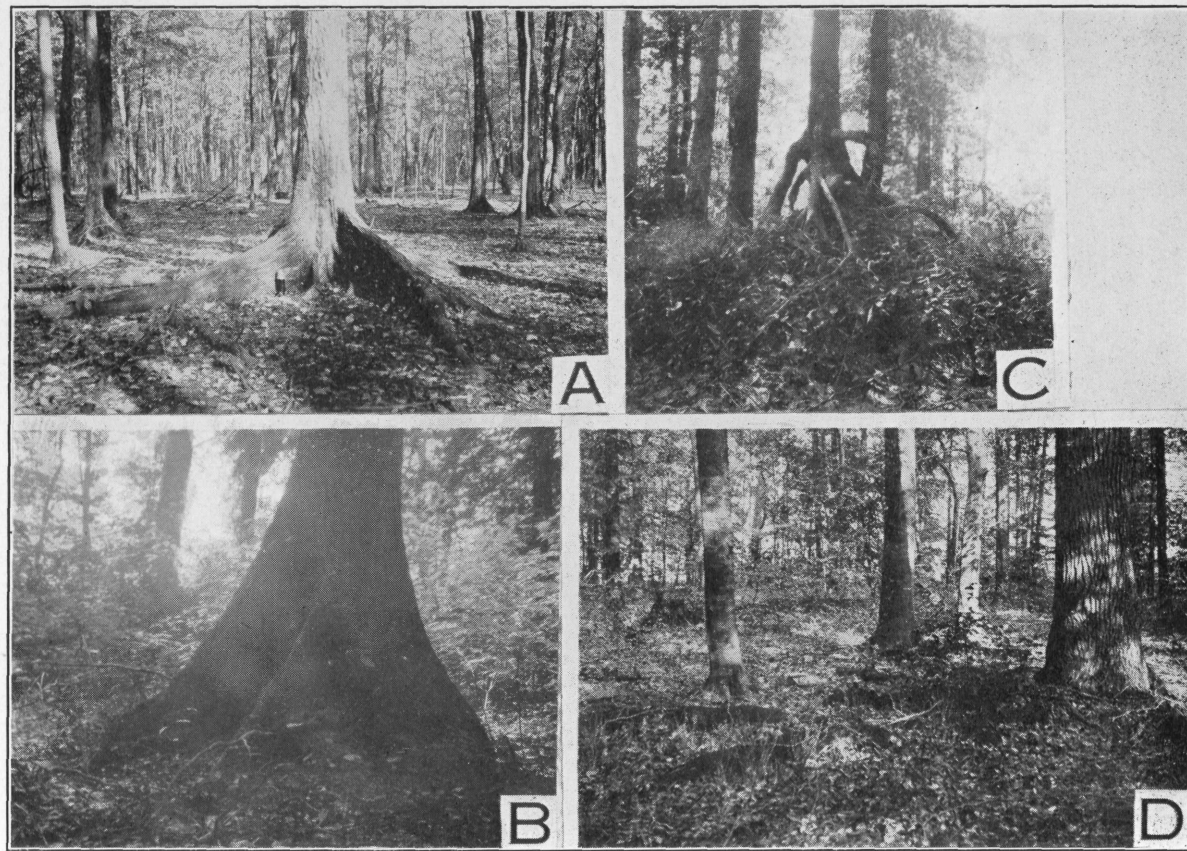


FIG. 1. A. Base of white elm showing "plank buttresses." The Thermos bottle gives scale.  
 B. Pyramidal buttressed base of elm.  
 C. Base of young elm; no erosion or removal of soil was possible in the situation in which the tree is growing.  
 D. Sweet gum with spreading superficial roots. Tree in wet soil in beech-white oak-sweet gum community.

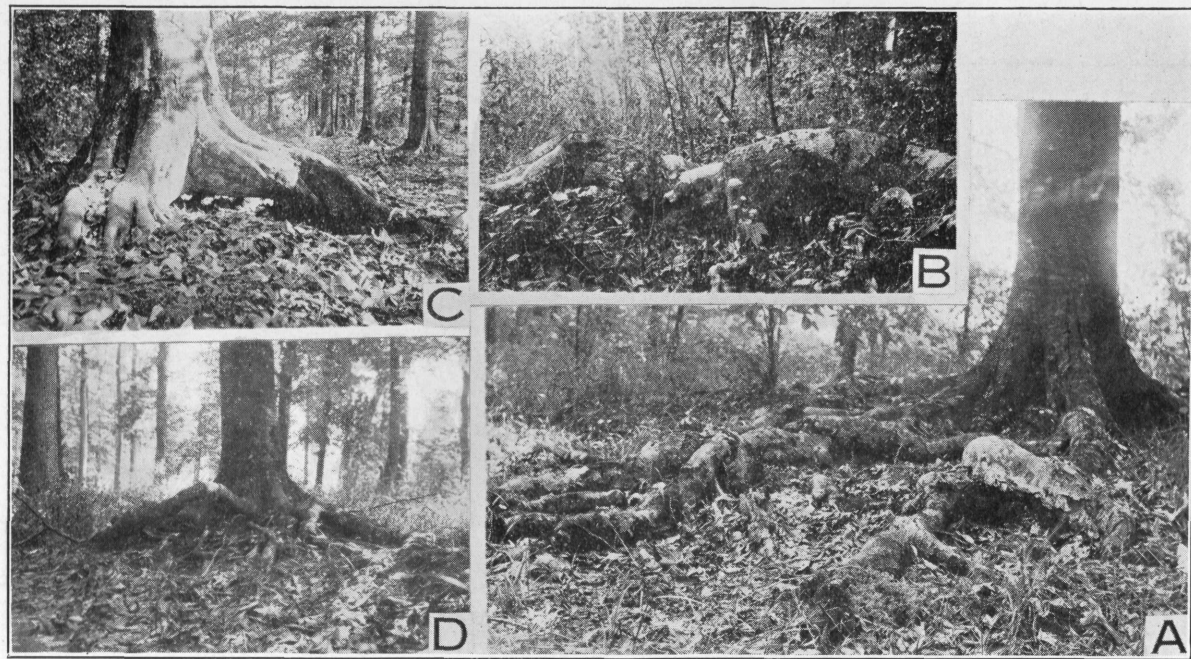


FIG. 2. Variations in form of beech.

- A. Roots of large tree crawling on surface of ground; these superficial roots afford favorable habitats for a variety of mosses and lichens.
- B. Close-up view of arching root.
- C. Trunk elevated above forest floor by three large roots.
- D. Peculiarly arching roots of beech.

members. In contrast, the greater abundance of shrubs and herbaceous plants in certain pin oak and white oak communities, both primary and secondary, may be due to the lesser root competition in these communities.

Many of the shrubs of the wet flats have superficial root systems. *Spiraea* bushes (*Spiraea tomentosa*) can frequently be lifted from the ground with almost no effort; most of the roots spread in the shallow layer of leaf litter; few penetrate the mineral soil beneath (Fig. 3). *Ilex verticillata* is similar in root habit (Fig. 4A, B, C). The habitat in which these shrubs commonly grow in the till plain is characterized not only by the high water table and poorly aerated soil, but also

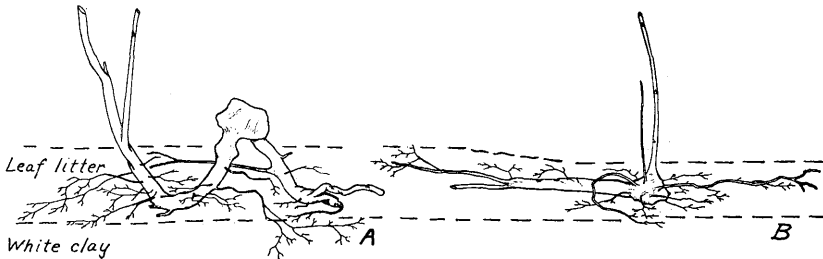


FIG. 3. Root habit of *Spiraea tomentosa*. Roots largely confined to layer of leaf duff on "white clay" or Clermont silt loam.

by the formation of a definite layer of leaf duff of the type described by Romell and Heiberg.<sup>2</sup> It is in this duff that root development takes place. It is possible that the absence of certain of the more characteristic shrubs of the till plain communities from some of the larger areas of the flats may be due to drying out during extreme droughts; the position of the root system makes this highly probable.

Some herbaceous plants in their root systems show a response to soil conditions. Both shallow and penetrating root systems are found. In some, as *Stellaria longifolia*, the roots are in the leaf duff. Regardless of situation, *Gentiana Saponaria* has a deeply penetrating root system. Such plants as *Gnaphalium polycephalum*<sup>3</sup> and *Sabbatia angularis*, both of which have tap roots, assume shallow root systems in poorly aerated soils.

<sup>2</sup>Romell, L. G. and S. Heiberg. Types of humus layer in the forests of north-eastern United States. *Ecol.* 12: 567-608. 1931.

<sup>3</sup>Guhman, Helen. Variations in the root system of the common everlasting (*Gnaphalium polycephalum*). *Ohio Jour. Sci.* 24: 199-208. 1924.

Peculiarities of root systems are assumed in response to environmental factors—high water table, poor soil aeration,

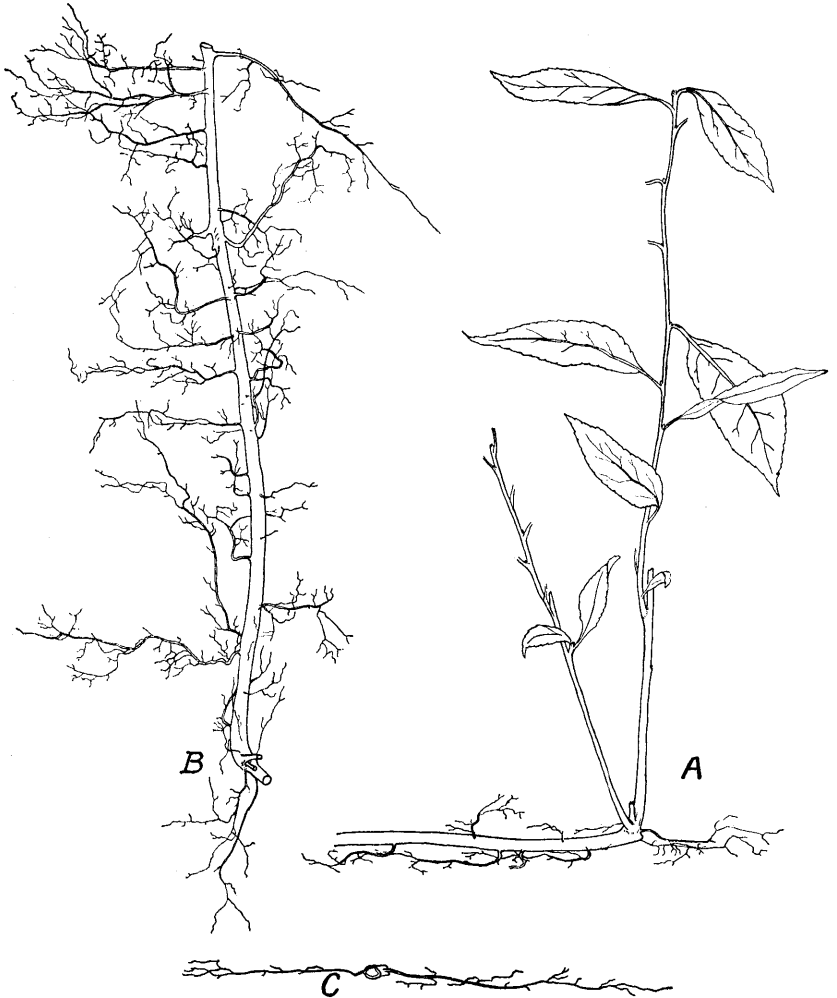


FIG. 4. Root habit of *Ilex verticillata*.

A. General view of root system.

B. Large root as seen from above showing extensive development of laterals all essentially in horizontal plane as shown in C.

leaf duff formation, and occasionally frost action. The assumption of superficial root systems by certain trees increases root competition in surface soils.